61. $s = a\cos(2\pi bt)$ (with $2b$ written above b)

a, b constants

$a =$ amplitude

$b =$ frequency

$\frac{ds}{dt} = v = -2\pi b \cdot a \sin(2\pi bt)$ (with $2b$ written above each b)

doubling freq will double amplitude of velocity

double b ?
replace b with 2b

$\frac{d}{dt}\cos(2t) = -2\sin 2t$

$\frac{d}{dt}\cos(2\pi t) = -2\pi \sin 2\pi t$

$a = -2\pi b \cdot 2\pi b \cdot a\cos(2\pi bt)$

4x amplitude

$J = 2\pi b \cdot 2\pi b \cdot 2\pi b \cdot \sin(2\pi bt)$

8x old amplitude

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55. tan & normal $y = 2\tan\left(\frac{\pi x}{4}\right)$ at $x=1$

$\frac{\pi}{4}\cdot x$

$y=2$

$y' = \frac{\pi}{4}\cdot 2\sec^2\left(\frac{\pi}{4}x\right)\Big|_{x=1} = \frac{\pi}{2}\sec^2\left(\frac{\pi}{4}\right) = \pi$

$\sec^2\frac{\pi}{4} = \frac{1}{\cos^2\frac{\pi}{4}}$

$= \frac{1}{\left(\frac{\sqrt{2}}{2}\right)^2}$

$2 = \frac{1}{\left(\frac{2}{4}\right)}$

$y = \pi(x-1) + 2$

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37. $y = f(u) = \frac{2u}{u^2+1}$

$u = g(x) = 10x^2 + x + 1$

$g'(x) = \frac{du}{dx} = 20x + 1 = 1$

$x = 0$

$u = 1$

$\frac{d}{dx} f(g(x)) = g'(x)\cdot f'(g(x))$

$\frac{dy}{dx} = \frac{du}{dx}\cdot\frac{dy}{du}$

$= \frac{du}{dx}\cdot\frac{(u^2+1)2 - 2u\cdot 2u}{(u^2+1)^2}$

$= 1\cdot\frac{2\cdot 2 - 2\cdot 2}{2^2} = 0$

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3.6b Chain Rule

Repeated use of the chain rule. Find the derivatives of:

$g(t)=\tan(5-\sin 2t)$ $\quad u=2t$

$g'(t)=2\cdot(-\cos 2t)\cdot\sec^2(5-\sin(2t))$ $\quad v=5-\sin u$

$w=\tan v$

$f(x)=\sqrt[3]{1+\sin^2(3x)} = \left(1+(\sin(3x))^2\right)^{\frac{1}{3}}$

$f'=3\cdot\cos 3x\cdot 2\sin 3x\cdot\frac{1}{3}\left(1+\sin^2(3x)\right)^{-\frac{2}{3}}$

$u=3x$

$v=\sin u$

$W=1+v^2$

$y=W^{1/3}$

$(u+v)^4$

$h(x)=(\sin(x^3+2x)+\cos(5x))^4$

$=4(\underbrace{\sin(x^3+2x)}_{u}+\underbrace{\cos 5x}_{v})^3\cdot\left(\underbrace{(3x^2+2)\cos(x^3+2x)}_{u'}+-\underbrace{5\sin 5x}_{v'}\right)$

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Chain Rule for parametric equations

$$\boxed{\frac{dy}{dx}=\frac{dy/dt}{dx/dt}} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$$

Find the tangent to the hyperbola branch defined parametrically by

$x=\sec(t)\quad y=\tan(t)\quad -\frac{\pi}{2}<t<\frac{\pi}{2}$ $\quad$ at $t=\frac{\pi}{4}$

$$\frac{dy}{dx}=\frac{\sec^2 t}{\sec t\tan t}=\frac{\sec t}{\tan t}=\frac{2}{\sqrt{2}}=\text{slope}$$

$X=\sec\frac{\pi}{4}=\frac{2}{\sqrt{2}}$

$Y=\tan\frac{\pi}{4}=1$

$Y=\frac{2}{\sqrt{2}}\left(X-\frac{2}{\sqrt{2}}\right)+1$

$\frac{\sqrt{2}\cdot 2}{\sqrt{2}\cdot\sqrt{2}}=\sqrt{2}$

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Find the derivatives:

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Radians vs Degrees

$x^\circ=\frac{\pi}{180}x\ radians$

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